INF-2: Infiltration Trench Fact Sheet

An infiltration trench is a long, narrow, rock-filled trench with no outlet other than an overflow outlet. Runoff is stored in the void space between stones and infiltrates through the bottom and sides of the trench. Infiltration trenches provide the majority of their pollutant removal benefits through volume reduction. Pretreatment is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective. *Note: if an infiltration trench is "deeper than its widest surface dimension," or includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute runoff below the surface of the ground, it would probably be considered a "Class V Injection Well" under the federal Underground Injection Control (UIC) Program, which is regulated in California by U.S. EPA Region 9. A UIC permit may be required for such a facility (for details see* **http://www.epa.gov/region9/water/groundwater/uic-classv.html**).

Also known as:

- *French Drains*
- *Rock Trenches*
- *Exfiltration Trenches*
- *Soak-aways*
- *Soakage Trenches*

Infiltration Trench

Source: www.dot.ca.gov

Feasibility Screening Considerations

- Infiltration trenches shall pass infeasibility screening criteria to be considered for use
- Infiltration trenches, particularly deeper designs, may not provide significant attenuation of stormwater pollutants if underlying soils have high permeability; potential risk of groundwater contamination.
- The potential for groundwater mounding should be evaluated if depth to seasonally high groundwater (unmounded) is less than 15 feet.

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Drainage area area is ≤ 5 acres and has low to moderate sediment production.
- 2-3 percent of drainage area available for infiltration (generally requires less surface area than infiltration basins and bioretention areas without underdrain).
- Space available for pretreatment (biotreatment or treatment control BMP as described below).
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into shallow fill is approved by a geotechnical professional.
- Tributary area land uses include open areas adjacent to parking lots, driveways, and buildings, and roadway medians and shoulders.

OC-Specific Design Criteria and Considerations

☐ Must comply with local, state, and federal UIC regulations if applicable; a permit may be required.

- ☐ Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- ☐ For facilities with tributary area less than 1 acre and less than 3 foot depth, minimum separation to mounded seasonally high groundwater of 5 feet shall be observed.
- ☐ For facilities with tributary area greater than 1 acre or deeper than 3 feet, minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- ☐ Minimum pretreatment should be provided upstream of the infiltration trench, and water bypassing pretreatment should not be directed to the infiltration trench.
- ☐ Infiltration trenches should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- ☐ Ponded water should not persist within 1 foot of the surface of the facility for longer than 72 hours following the end of a storm event (observation well is needed to allow observation of drain time).
- ☐ Energy dissipators should be provided at inlet and outlet to prevent erosion.
- ☐ An overflow device must be provided if basin is on-line.
- ☐ A minimum freeboard of one foot should be provided above the overflow device (for an on-line basin) or the outlet (for an off-line basin).
- ☐ Longitudinal trench slope should not exceed 3%.
- ☐ Side slopes above trench fill should not be steeper than 3:1.

Simple Sizing Method for Infiltration Trenches

If the Simple Design Capture Volume Sizing Method is used to size an infiltration trench, the user calculates the DCV and then designs the geometry required to draw down the DCV in 48 hours. The sizing steps are as follows:

Step 1: Determine Infiltration Basin DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1**.

Step 2: Determine the 48-hour Effective Depth

The depth of water that can be drawn down in 48 hours can be calculated using the following equation:

$d_{48} = K_{DESIGN} \times SACF \times 48 \text{ hours}$

Where:

d_{48} = trench effective 48-hour depth, ft

K_{DESIGN} = basin design infiltration rate, in/hr (See **Appendix VII**)

SACF = Surface Area Correction Factor = ranges from 1.0 (sides insignificant or not accounted) to 2.0 (sides plus bottom are 2 times the surface area of the bottom at mid depth) to account for the ratio of infiltration through the sides of the trench to the bottom footprint of the trench; should be based on anticipated trench geometry and wetted surface area at mid-depth.

This is the maximum effective depth of the trench below the overflow device to achieve drawdown in 48 hours.

Step 3: Determine the Trench Ponding Depth and Trench Depth

The depth of water stored in the ponding depth (i.e. above the trench fill) and within the trench itself should be equal or less than d_{48}. Determine the ponding depth and the trench fill depth such that:

$$d_{48} \geq (n_T \times d_T + d_P)$$

Where:

d_{48} = trench effective 48-hour depth, ft (from Step 2)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft (should not exceed 1 ft)

Step 4: Calculate the Required Infiltrating Area

The required footprint area can be calculated using the following equation:

$$A = DCV/ ((n_T \times d_T) + d_P)$$

Where:

A = required trench footprint area, sq-ft

DCV = design capture volume, cu-ft (see Step 1)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

Capture Efficiency Method for Infiltration Trenches

If BMP geometry has already been defined and deviates from the 48 hour drawdown time, the designer can use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (**Appendix III.3.2**) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected trench geometry

$$DD = ((n_T \times d_T) + d_P) / (K_{DESIGN} \times SACF) \times 12$$

Where:

DD = time to completely drain infiltration basin ponding depth, hours

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

SACF = Surface Area Correction Factor = ranges from 1.0 (sides insignificant or not accounted) to 2.0 (sides plus bottom are 2 times the surface area of the bottom at mid depth) to account for the ratio of infiltration through the sides of the trench to the bottom footprint of the trench; should be based on anticipated trench geometry and wetted surface area at mid-depth.

K_{DESIGN} = basin design infiltration rate, in/hr (See **Appendix VII**)

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (**Appendix III.3.2**) to calculate the required fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the trench drawdown time calculated above.

Step 3: Determine the Trench Infiltrating Area Needed

The required footprint area can be calculated using the following equation:

$A = DCV / ((n_T \times d_T) + d_P)$

Where:

A = required trench footprint area, sq-ft

DCV = design capture volume, cu-ft (see Step 1)

n_T = porosity of trench fill; 0.35 may be assumed where other information is not available

d_T = depth of trench fill, ft

d_P = ponding depth, ft

If the area required is greater than the selected trench area, adjust surface area or adjust ponding and/or trench depth and recalculate required area until the required area is achieved.

Configuration for Use in a Treatment Train

- Infiltration trenches may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required volume of the trench.
- Infiltration trenches must be preceeded by some form of pretreatment which may be biotreatment or a treatment control BMP; if an approved biotreatment BMP is used as pretreatment, the overflow from the infiltration trench may be considered “biotreated” for the purposes of meeting the LID requirments
- The overflow or bypass from an infiltration trench can be routed to a downstream biotreatment BMP and/or a treatment control BMP if additional control is required to achieve LID or treatment control requirements

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: **http://www.cabmphandbooks.com/Documents/Development/TC-10.pdf**
- SMC LID Manual (pp 141): **http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf**
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 6: **http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandrainageareaintenance.pdf**
- City of Portland Stormwater Management Manual (Soakage Trenches, page 2-82) **http://www.portlandonline.com/bes/index.cfm?c=47954&a=202883**
- San Diego County LID Handbook Appendix 4 (Factsheet 1): **http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf**